

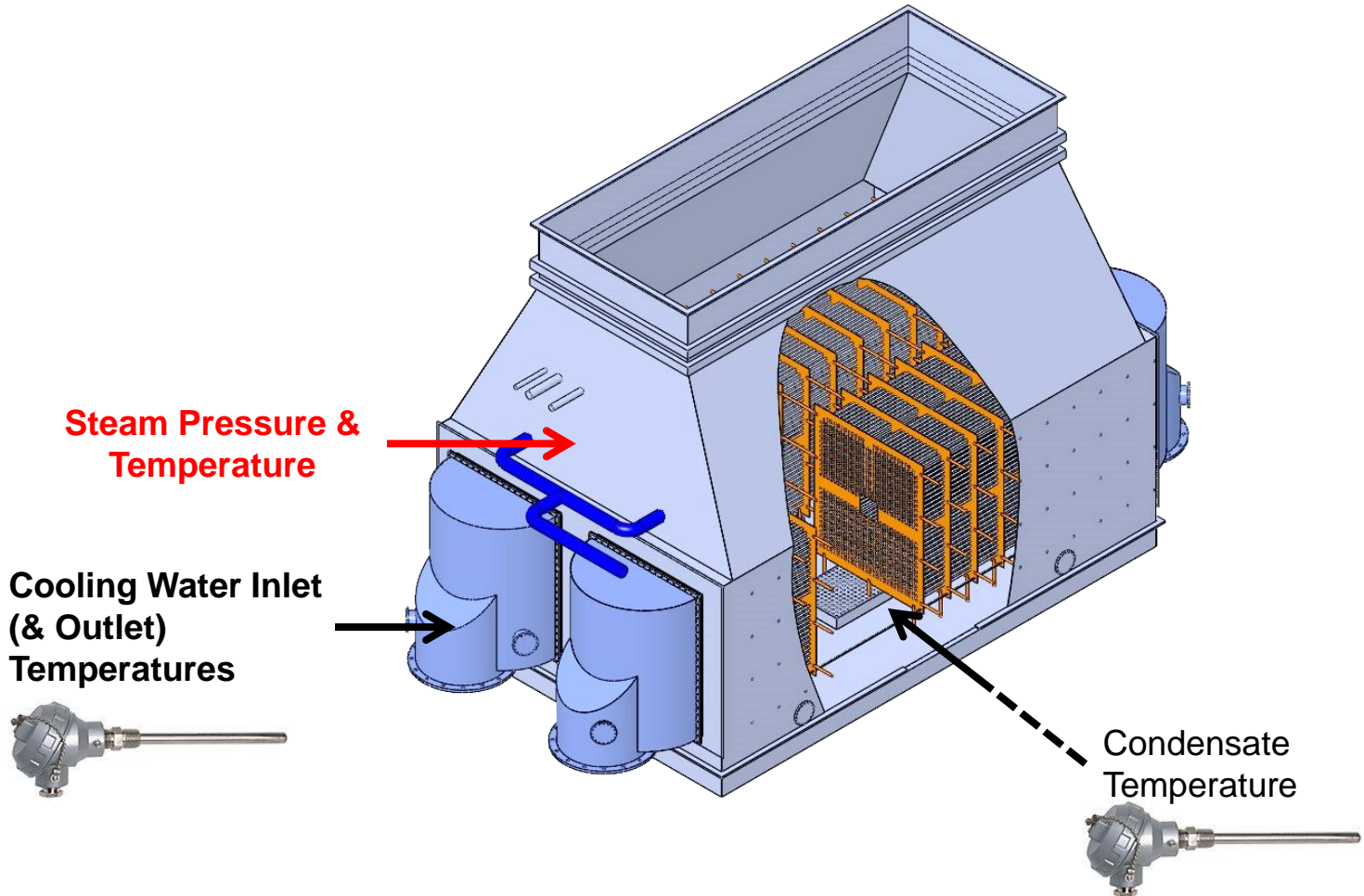
CCUG 2021

Condenser Performance Monitoring with Advanced Instrumentation

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Condenser Instrumentation



Defining Performance Degradation Mechanisms

Gross Generation	Condenser Design Pressure	Measured Condenser Pressure	Excess Condenser Pressure
100 MW	2.0"HgA	2.6"HgA	0.6"Hg
300 MW	2.5"HgA	3.3"HgA	0.8"Hg
700 MW	3.5"HgA	4.7"HgA	1.2"Hg

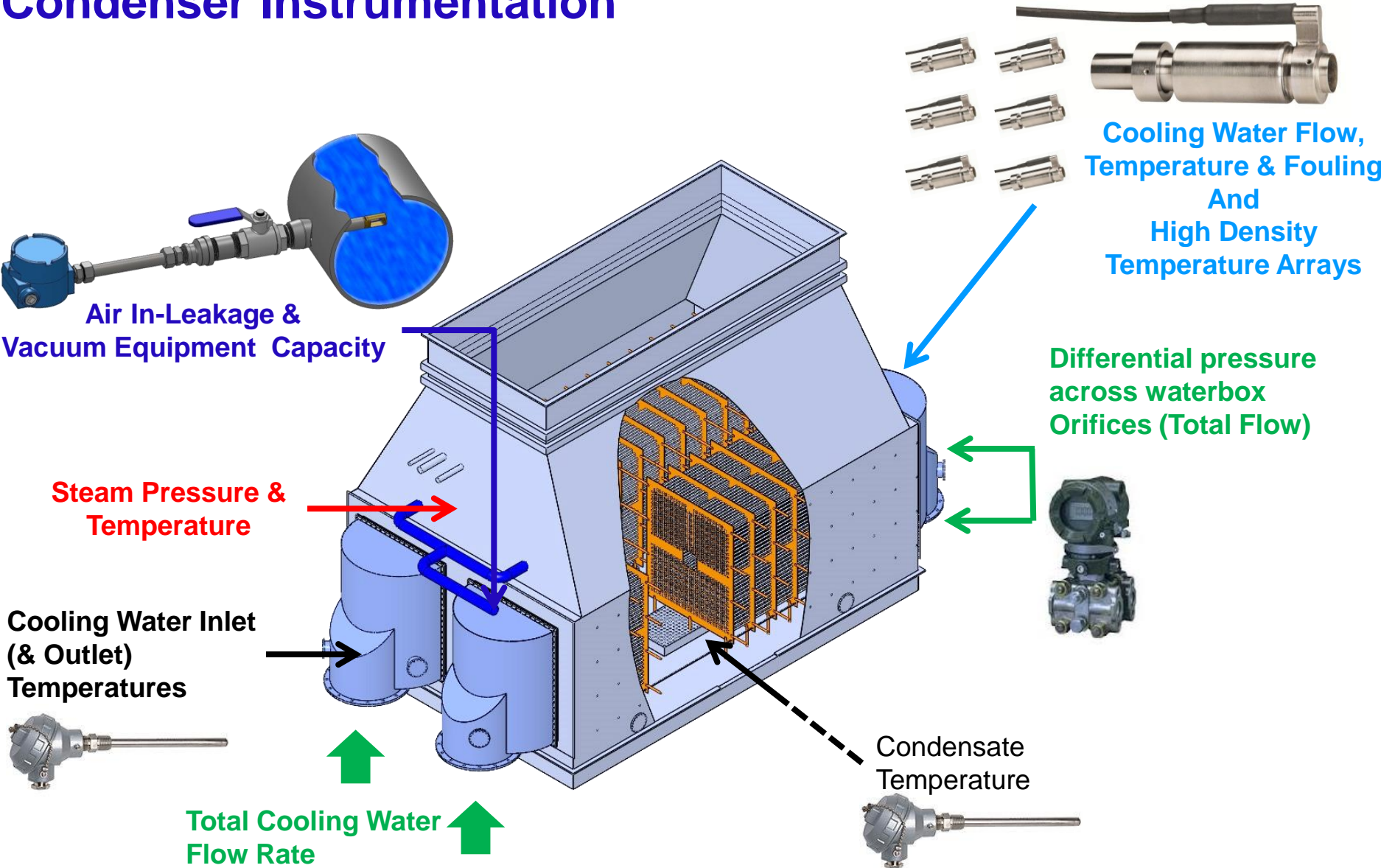
*Quantifiable
Excess BP Using
Average Value
Parameters*

Cleanliness Factor (%)

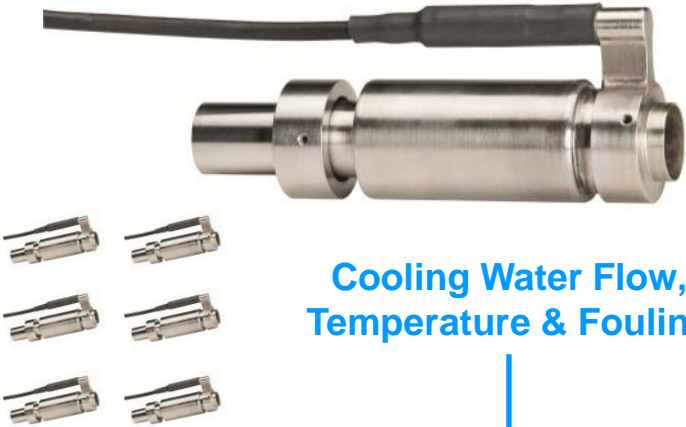
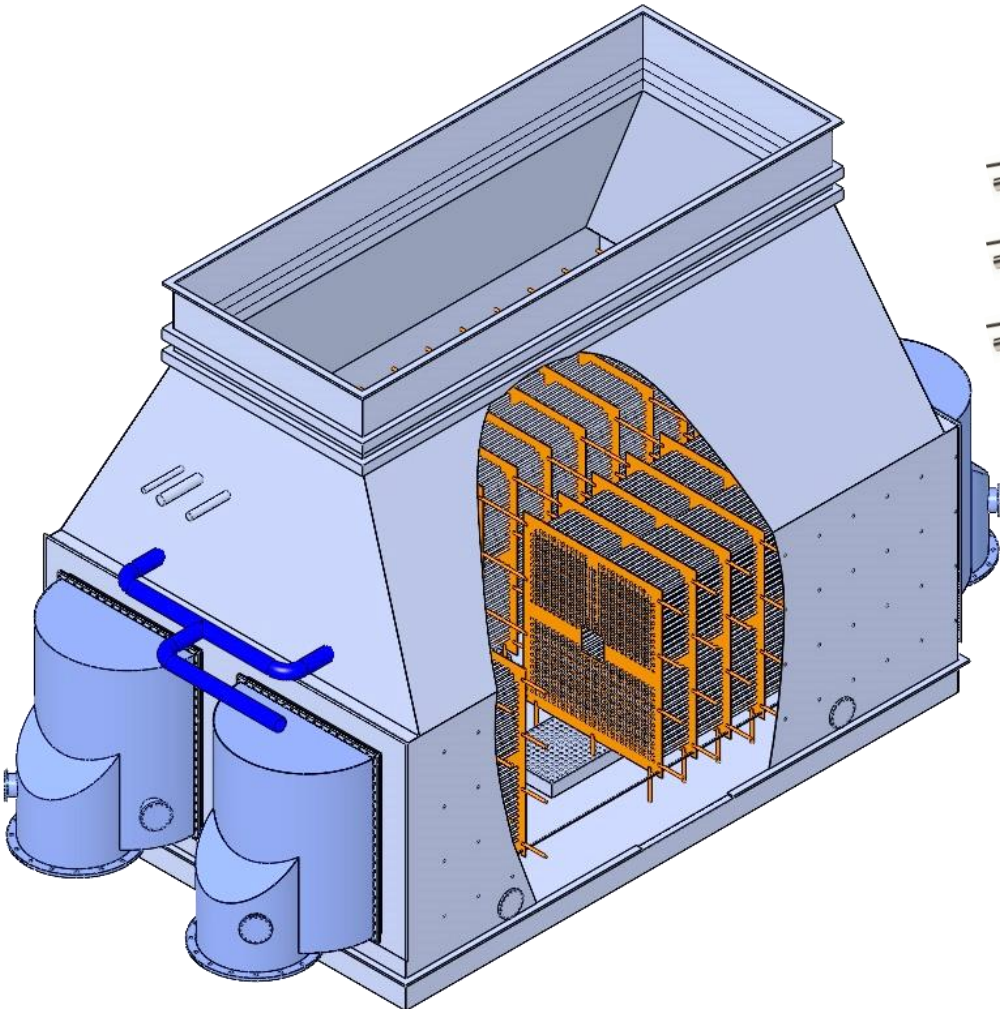
Excess Condenser Pressure	Low CW Flow Rate	Air Storage			Micro-fouling	Macro-fouling
		High Air In-leak	Ineffective Venting	Air Binding		
0.6"Hg						
0.8"Hg						
1.2"Hg						

*Real-Time Quantifiable Excess BP Components Using Intek's
Comprehensive Condenser Monitoring and Analysis Approach*

Condenser Instrumentation



Tubesheet Instruments: Flow & Temperature



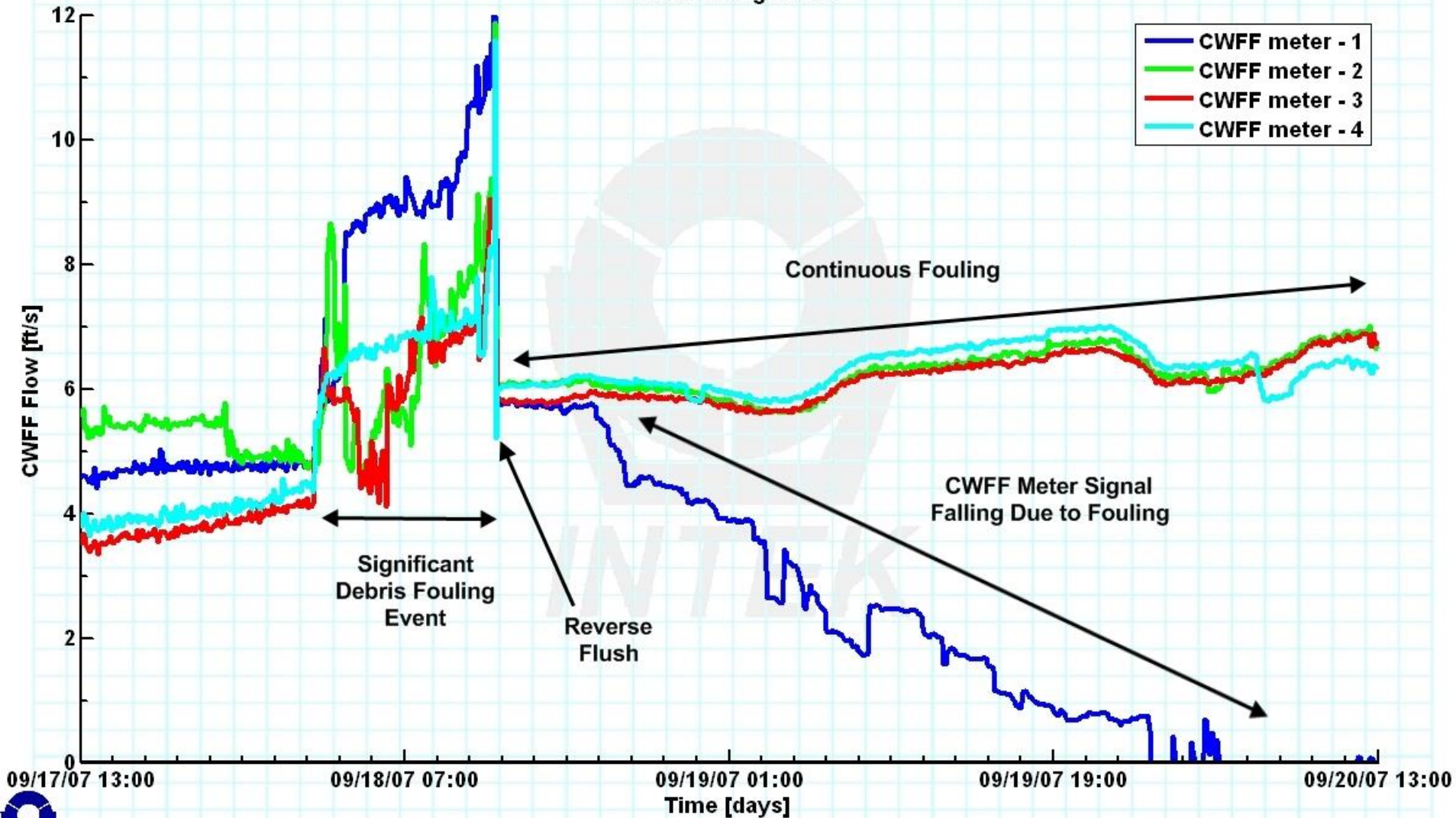
Cooling Water Flow,
Temperature & Fouling





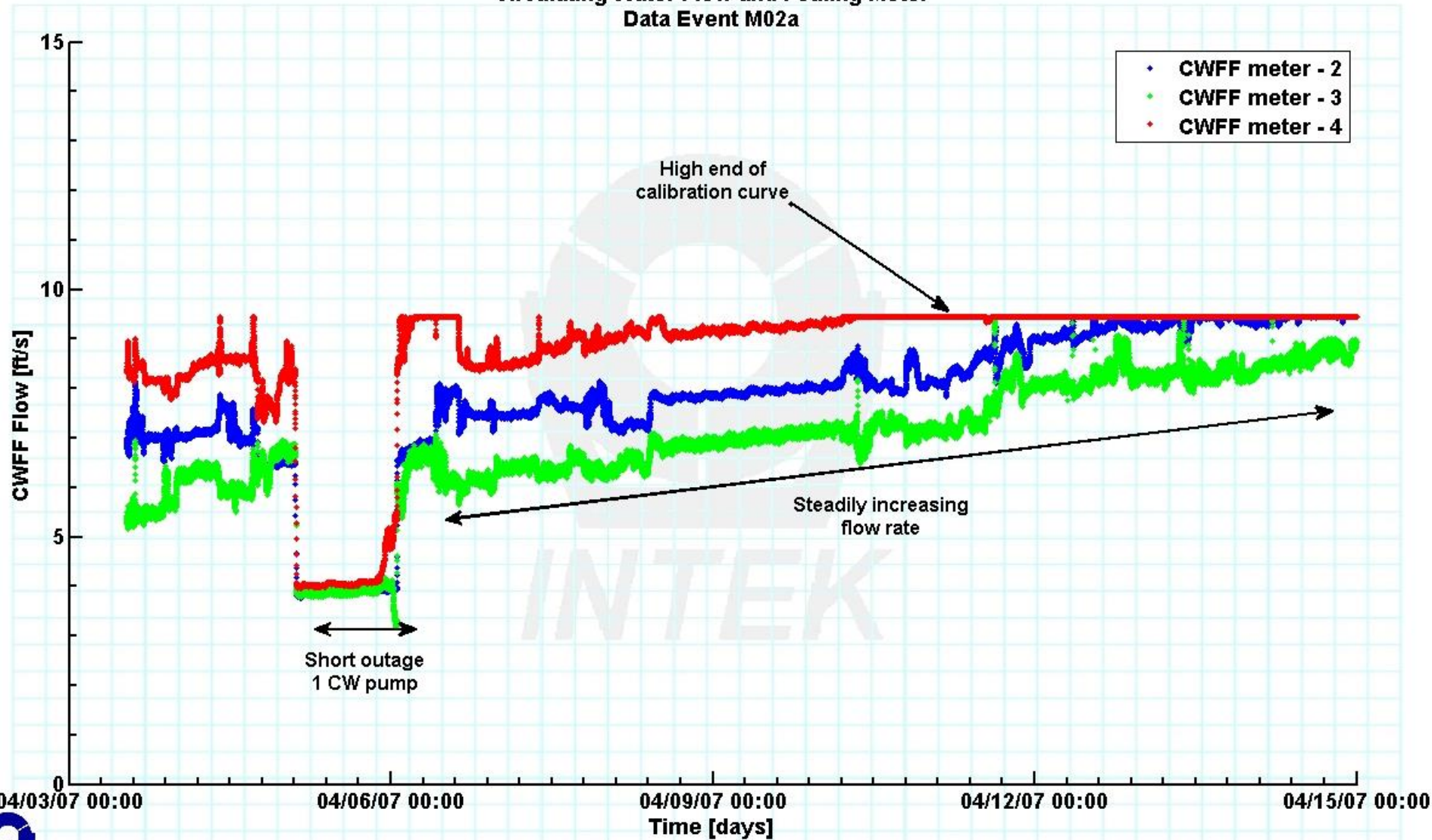
Case Study

Circulating Water Flow and Fouling Meter
MacroFouling Event

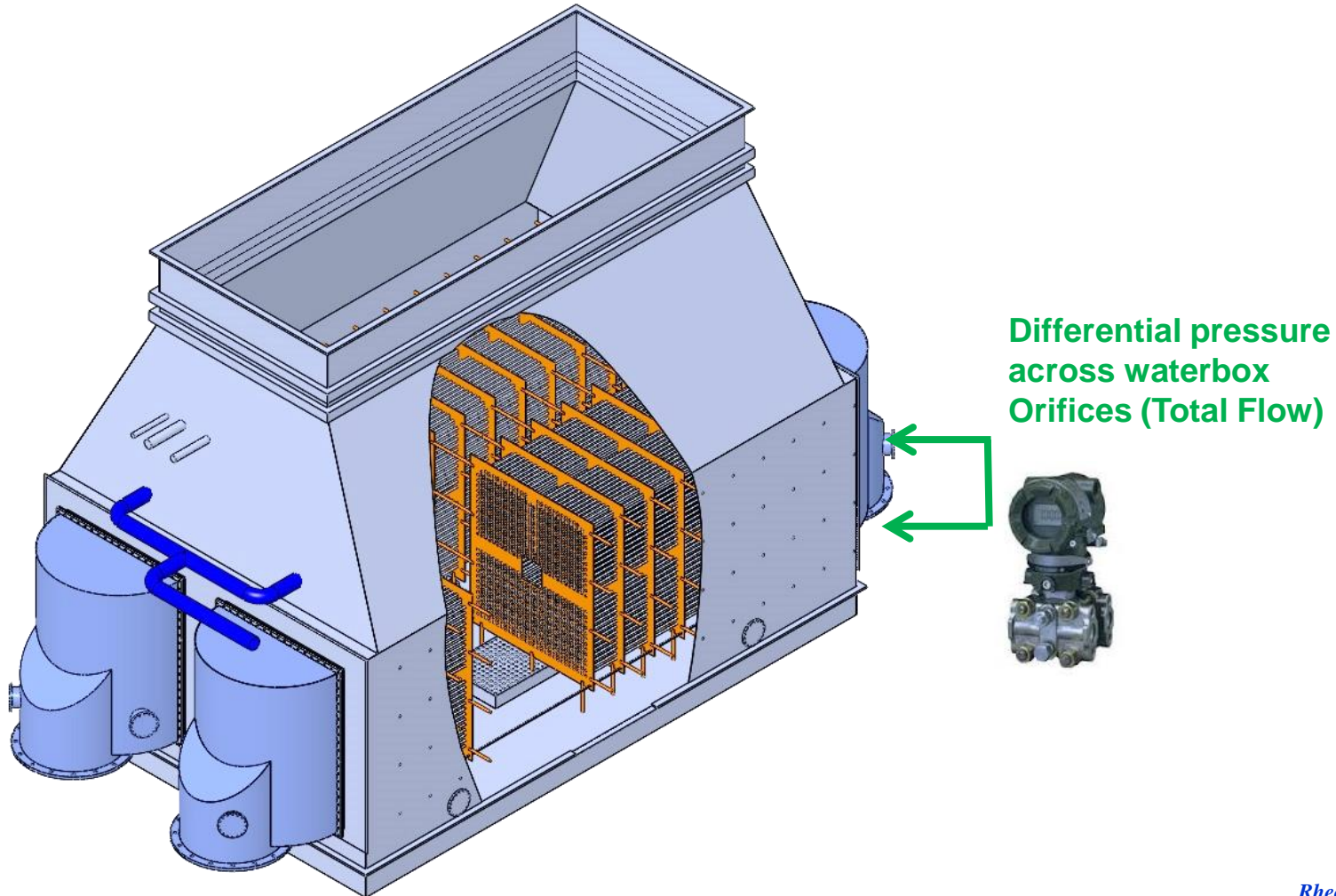


Case Study

Circulating Water Flow and Fouling Meter
Data Event M02a



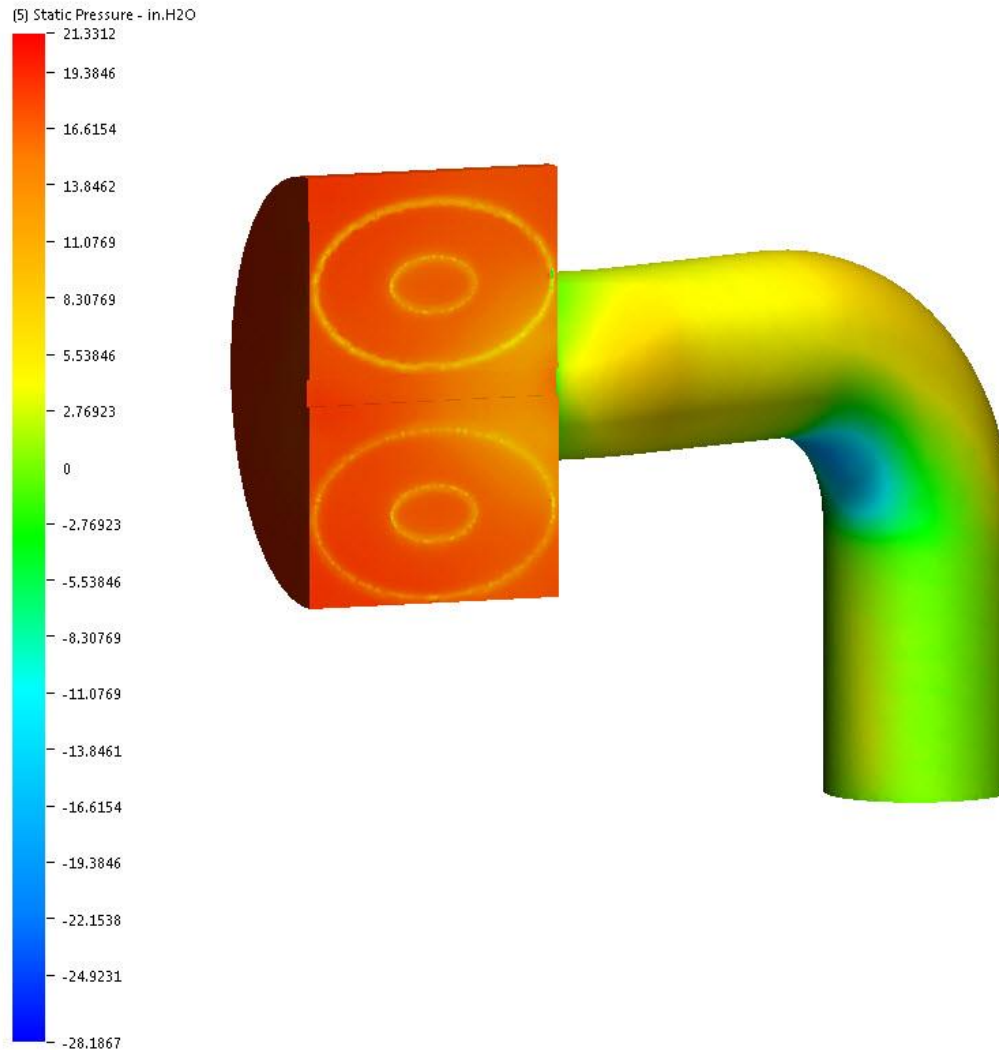
Cooling Water Flow Rate DP Meter



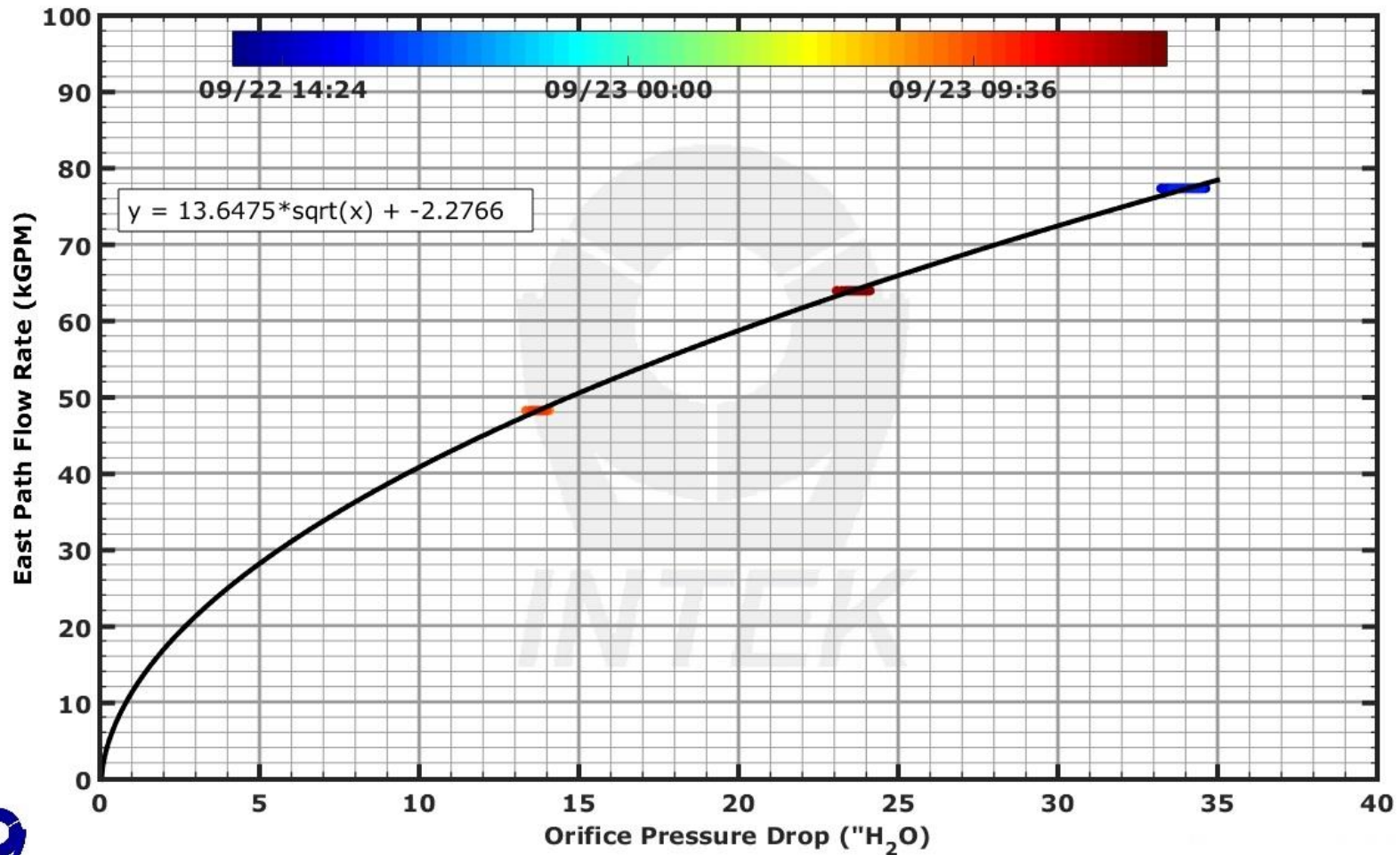
Cooling Water Flow Rate DP Meter

- **Existing differential pressure producing features in the circulating water piping**
 - Waterbox-pipe orifice
 - Elbows
- **Repeatable and measurable pressure drops can be correlated to circulating water flow rate**

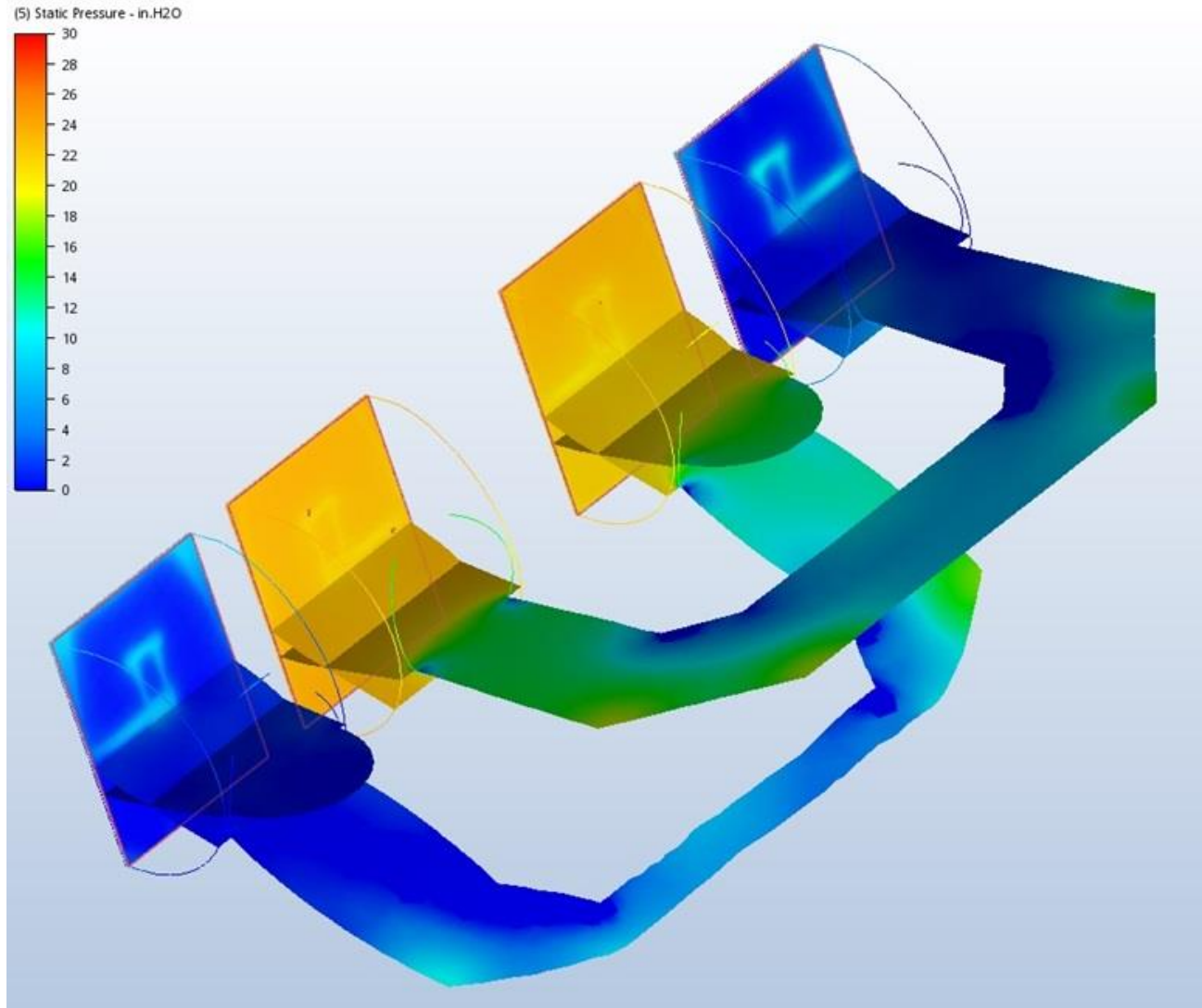
Cooling Water Flow Rate DP Meter



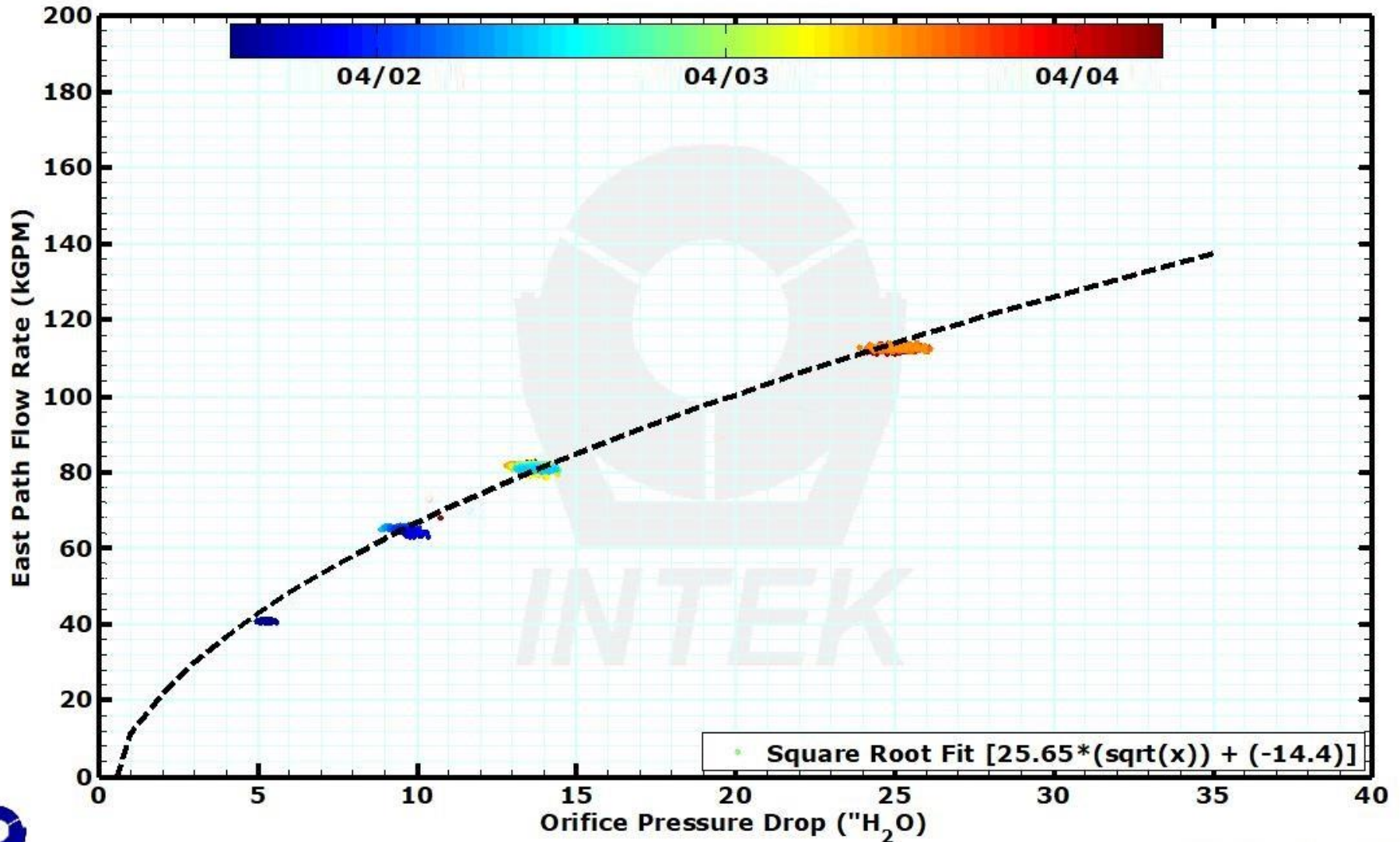
Cooling Water Flow Rate DP Meter



Cooling Water Flow Rate DP Meter



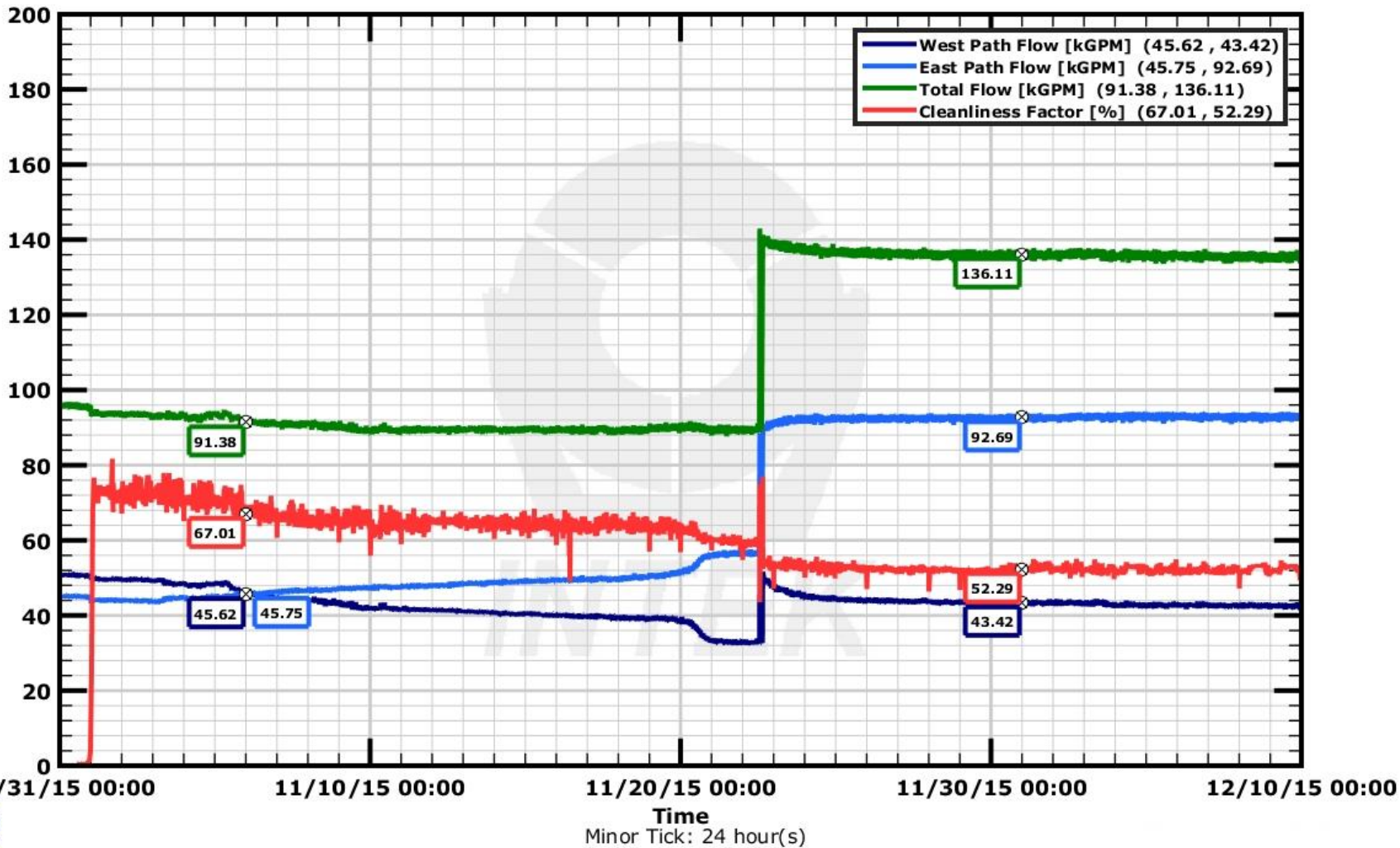
Cooling Water Flow Rate DP Meter



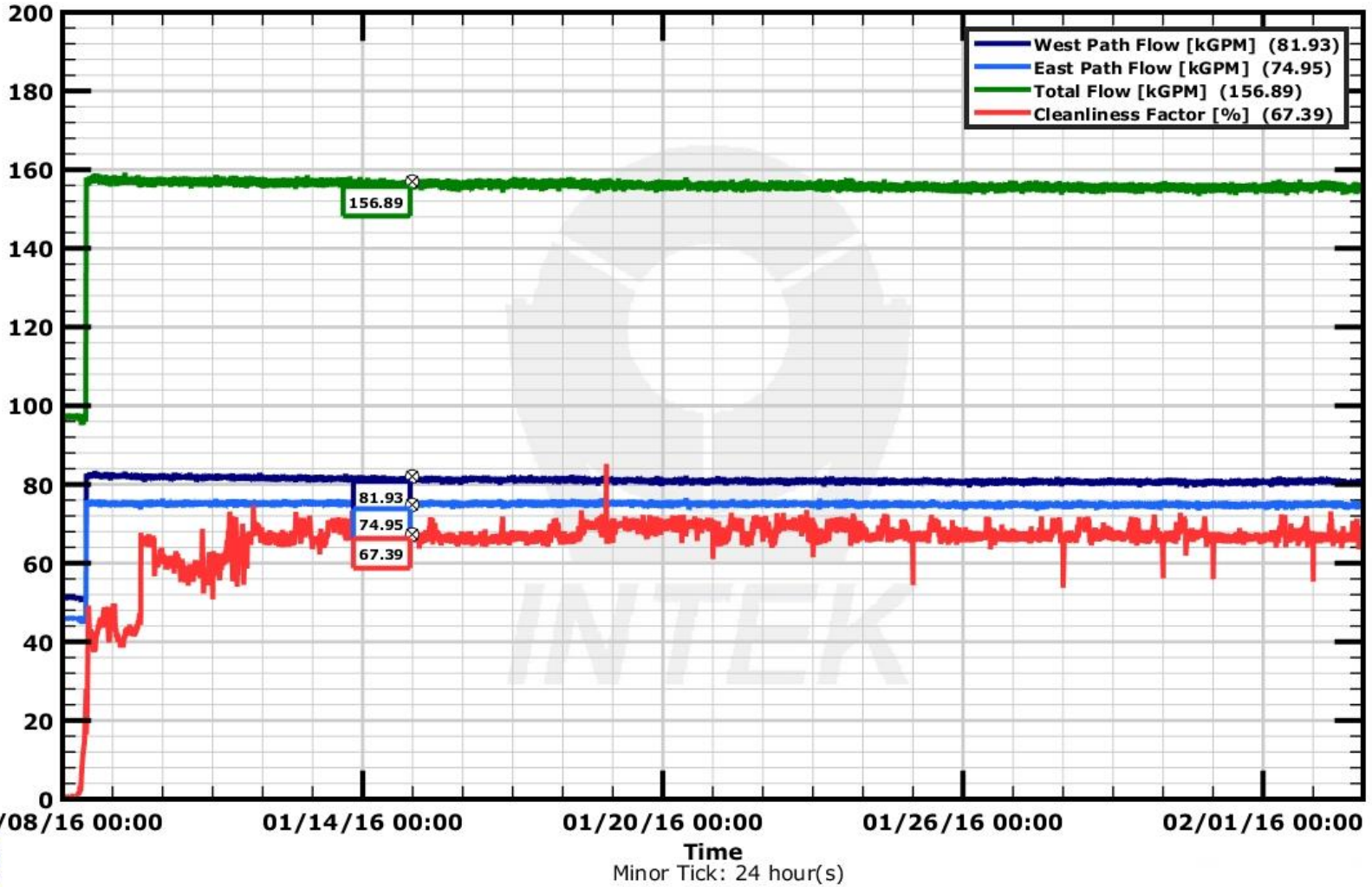
Cooling Water Flow Rate DP Meter

- **Installation locations to avoid**
 - Near ball cleaning screens
 - Near butterfly valves
- **Special Considerations**
 - Compensation for remote seal fill fluid specific gravity difference and seal height
 - Calibration
 - Tap fouling/plugging

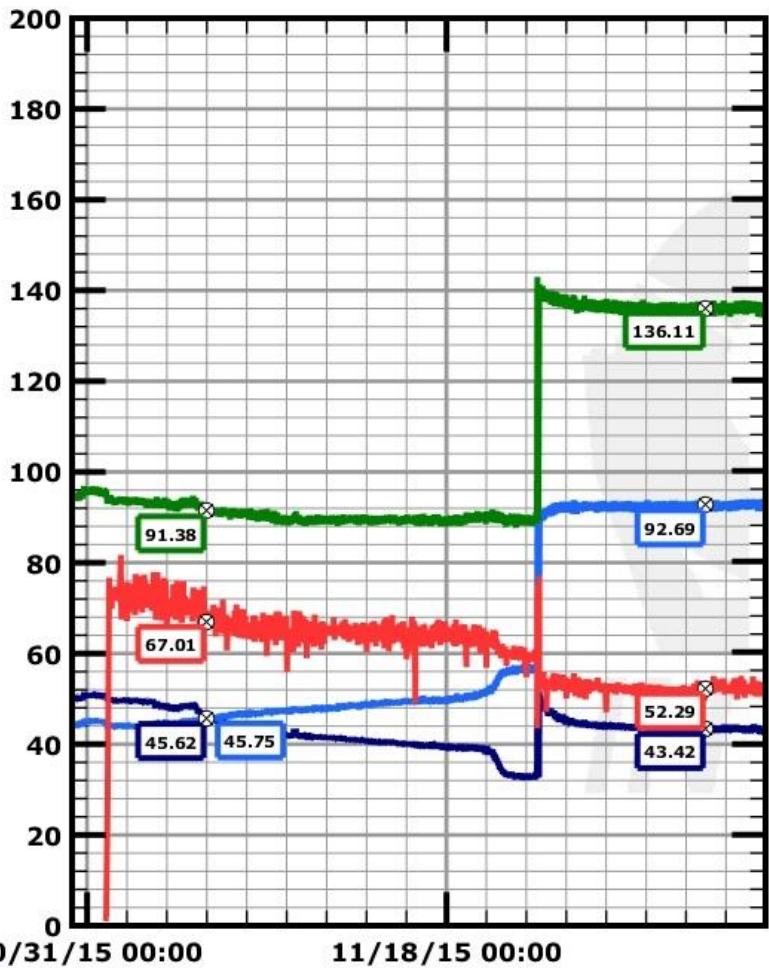
Case Study



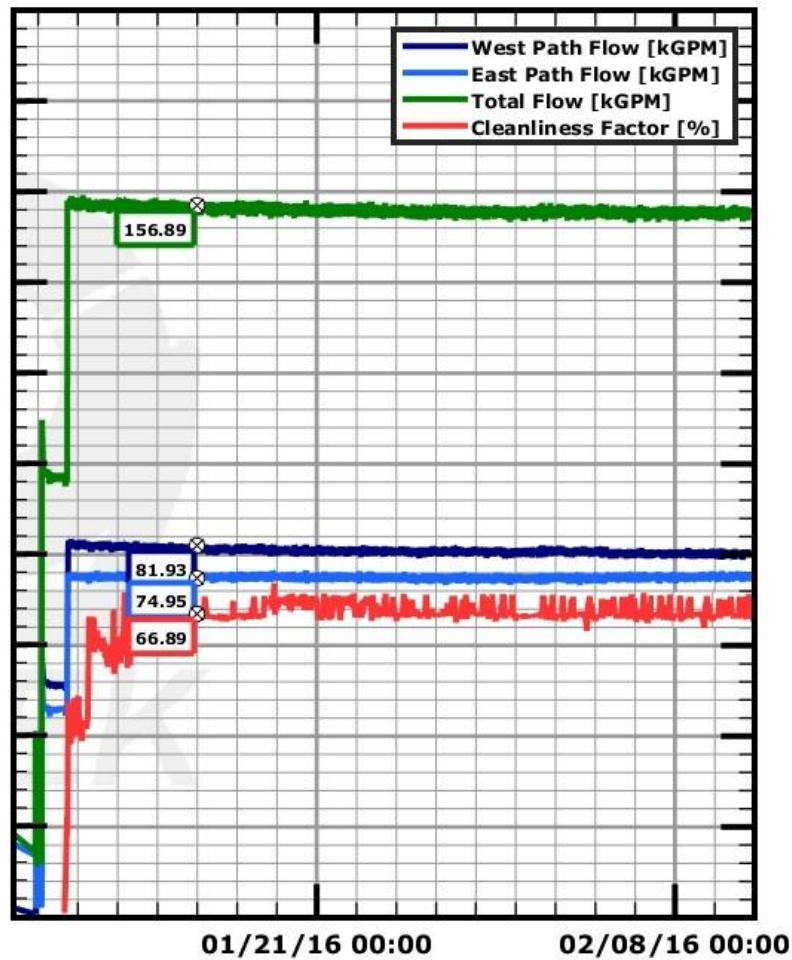
Case Study



Case Study



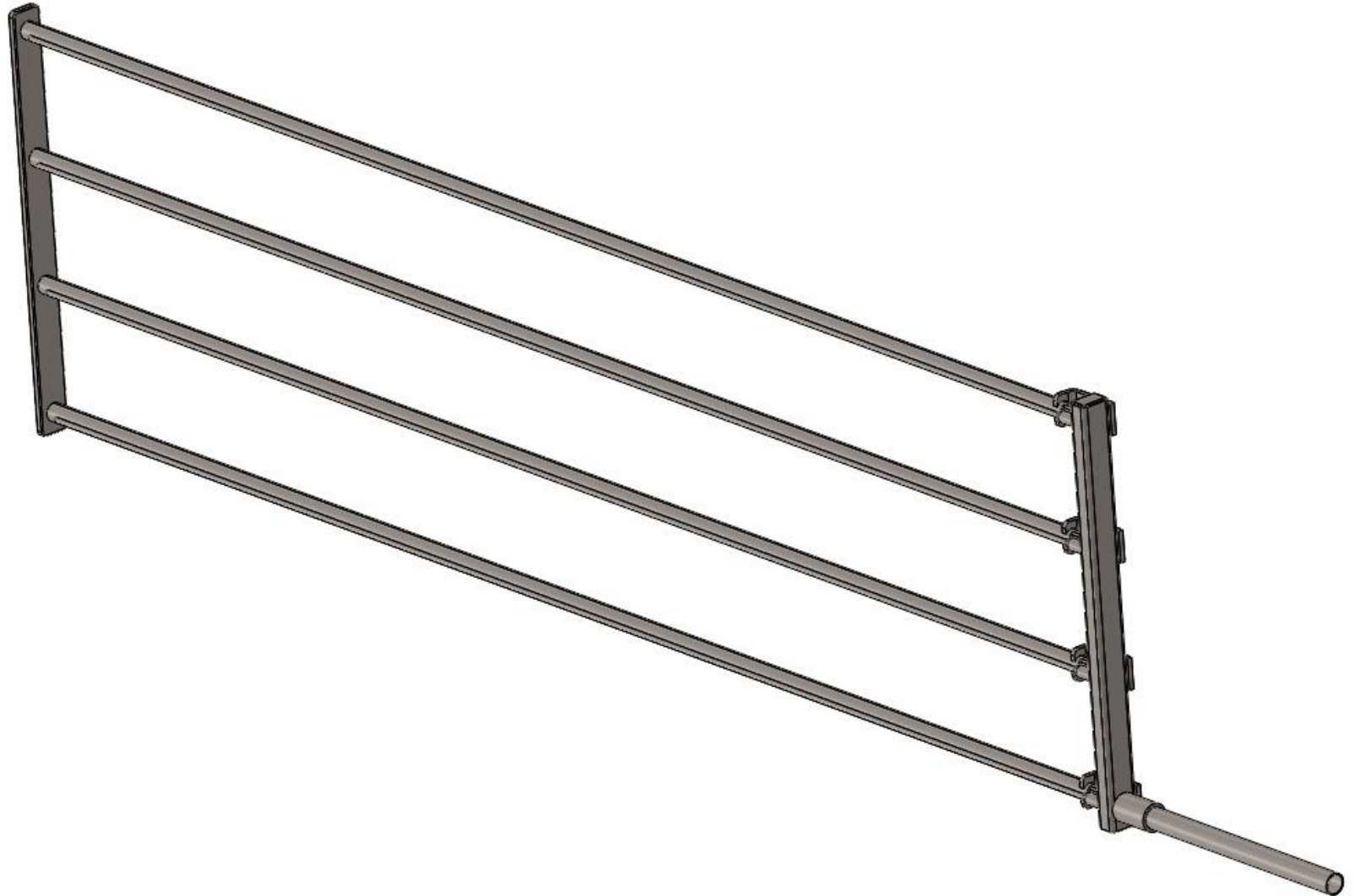
Initial Startup



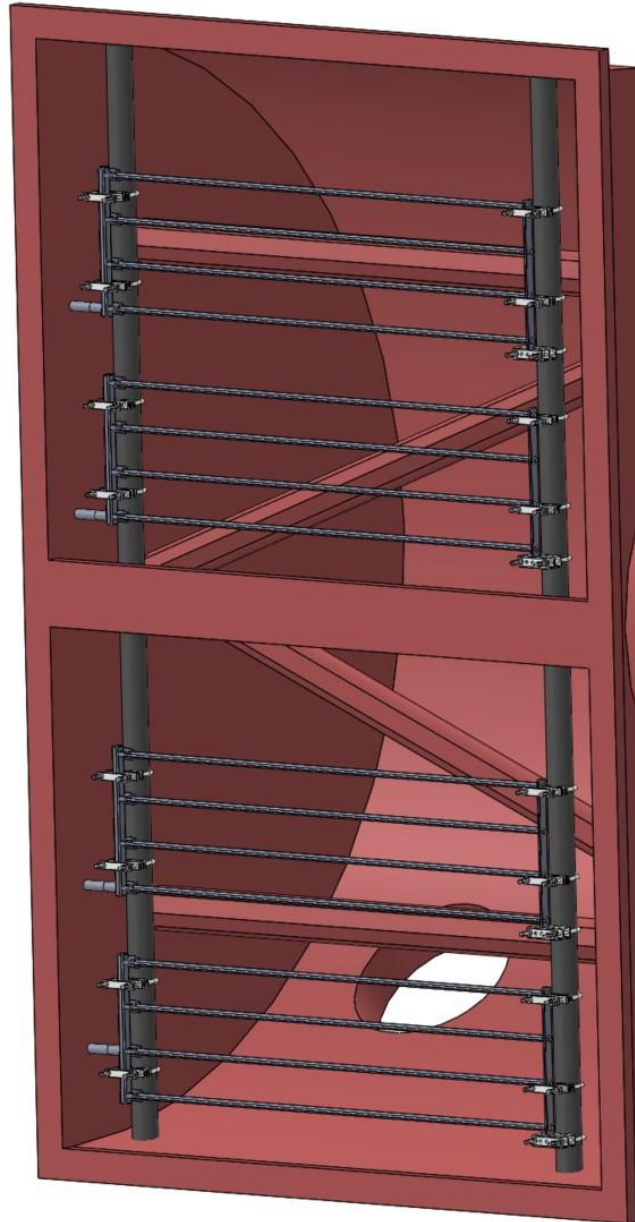
Post-cleaning



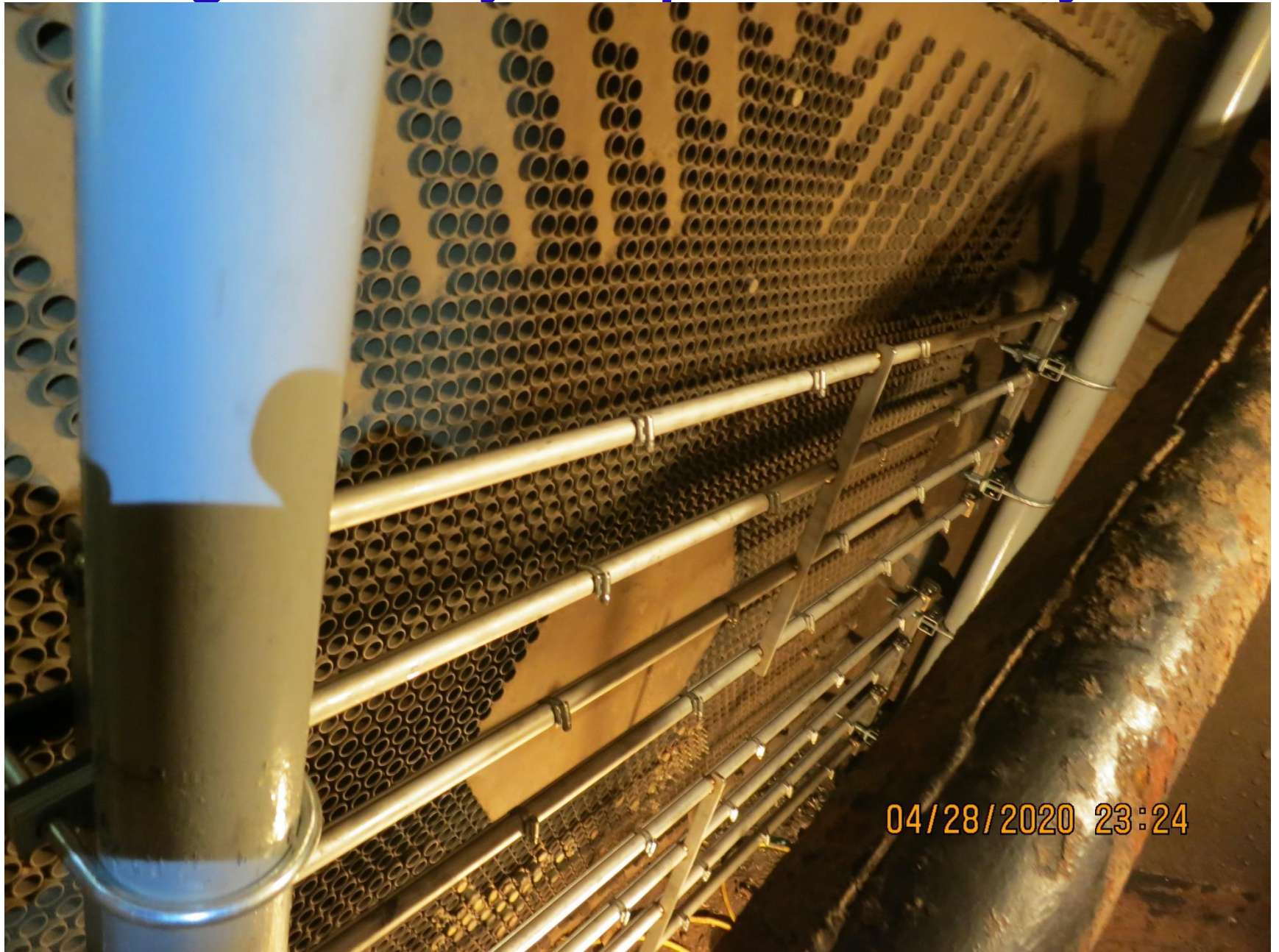
High-Density Temperature Array



High-Density Temperature Array



High-Density Temperature Array



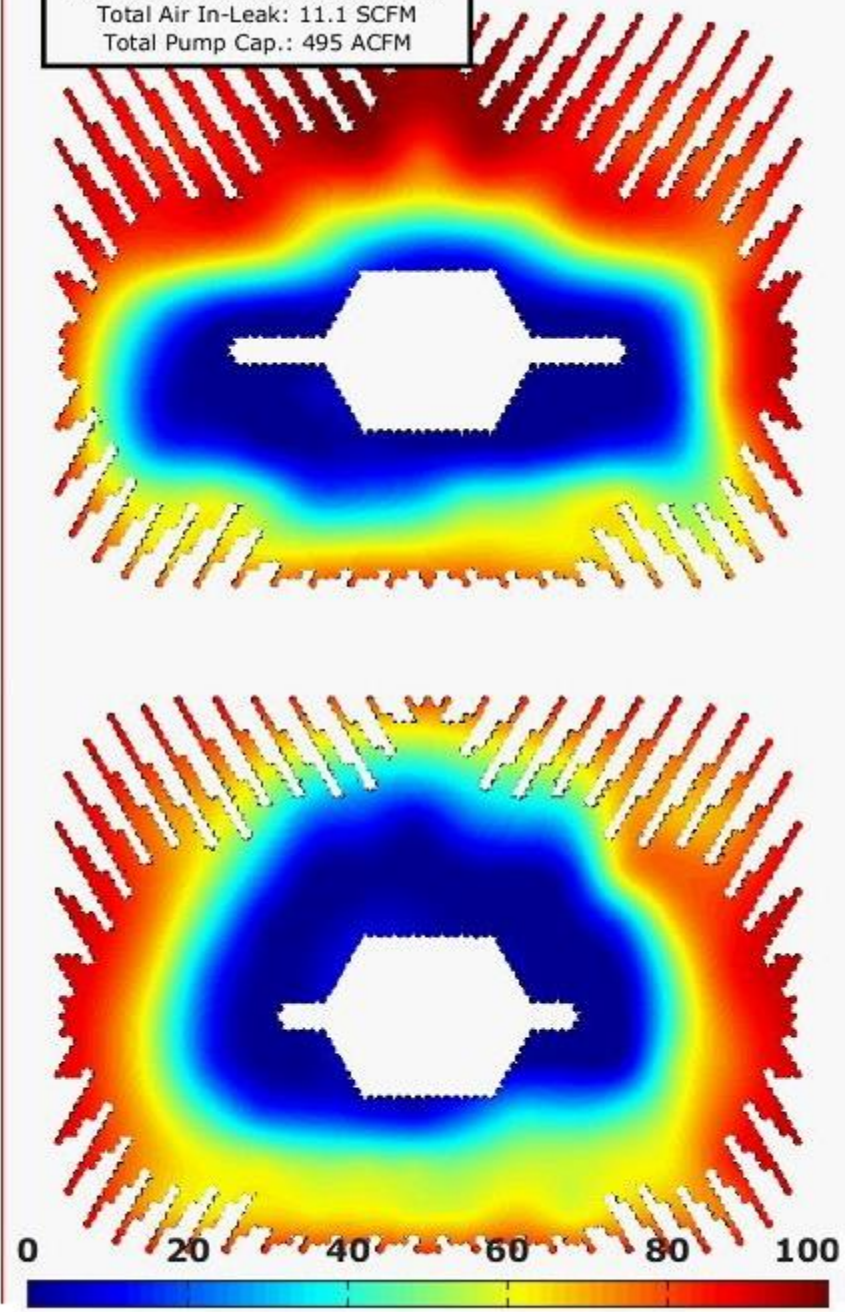
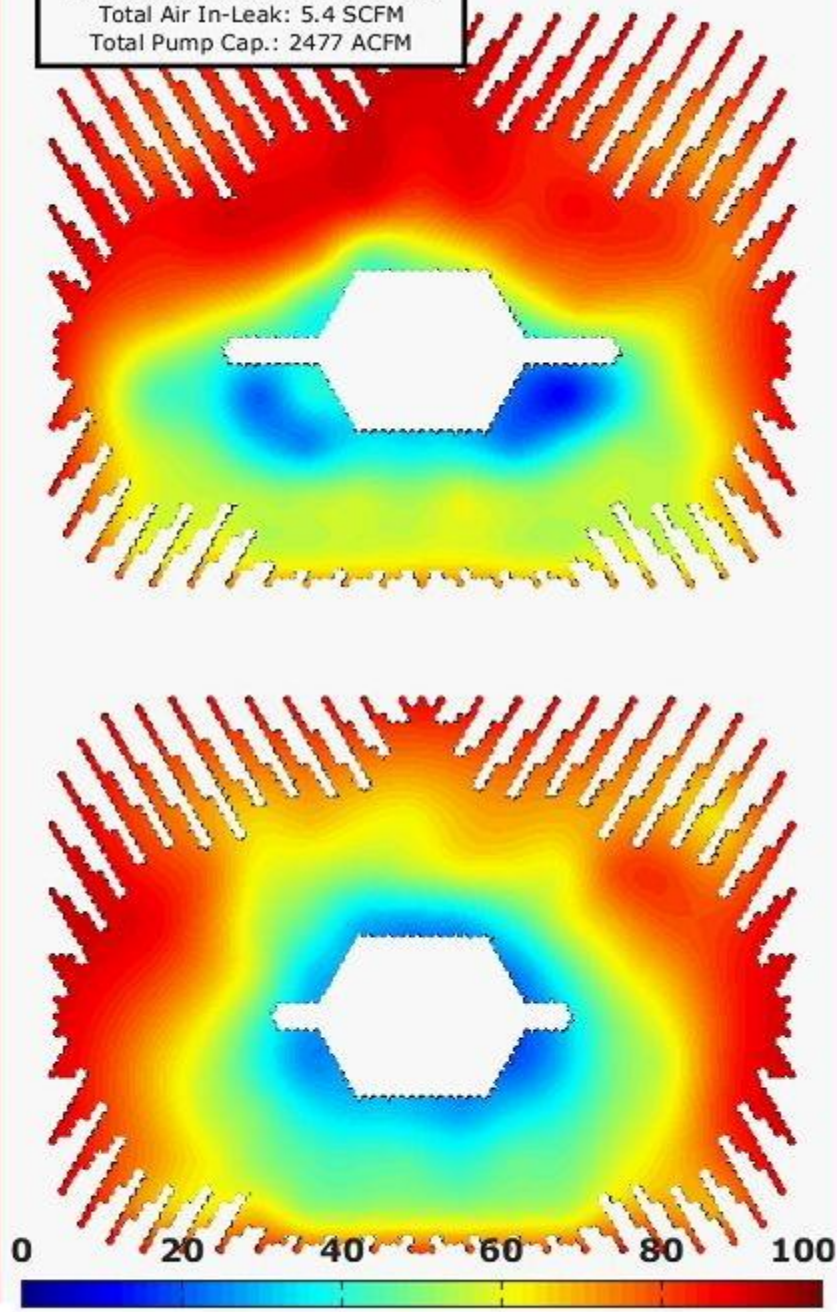
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High Density Temperature Array

- **Sized to fit through manways for ease of installation**
- **Temperature measurements can be up to 1 per inch**
- **Provide data on air binding and microfouling**

Bundle Cleanliness Factor: 70.3%
Total Air In-Leak: 5.4 SCFM
Total Pump Cap.: 2477 ACFM

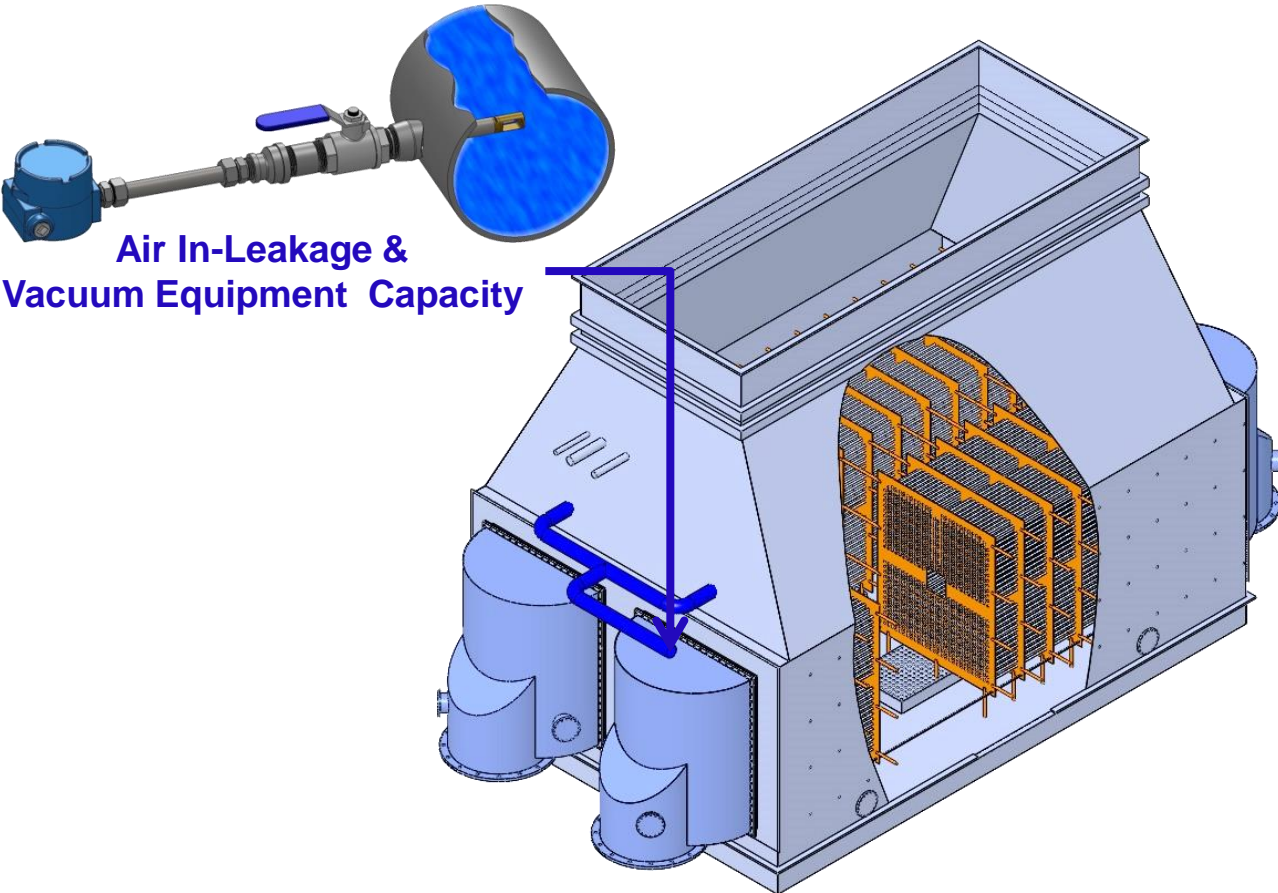
Bundle Cleanliness Factor: 57.8%
Total Air In-Leak: 11.1 SCFM
Total Pump Cap.: 495 ACFM



HEI Cleanliness Factor

HEI Cleanliness Factor

RheoVac Air In-Leak Monitors

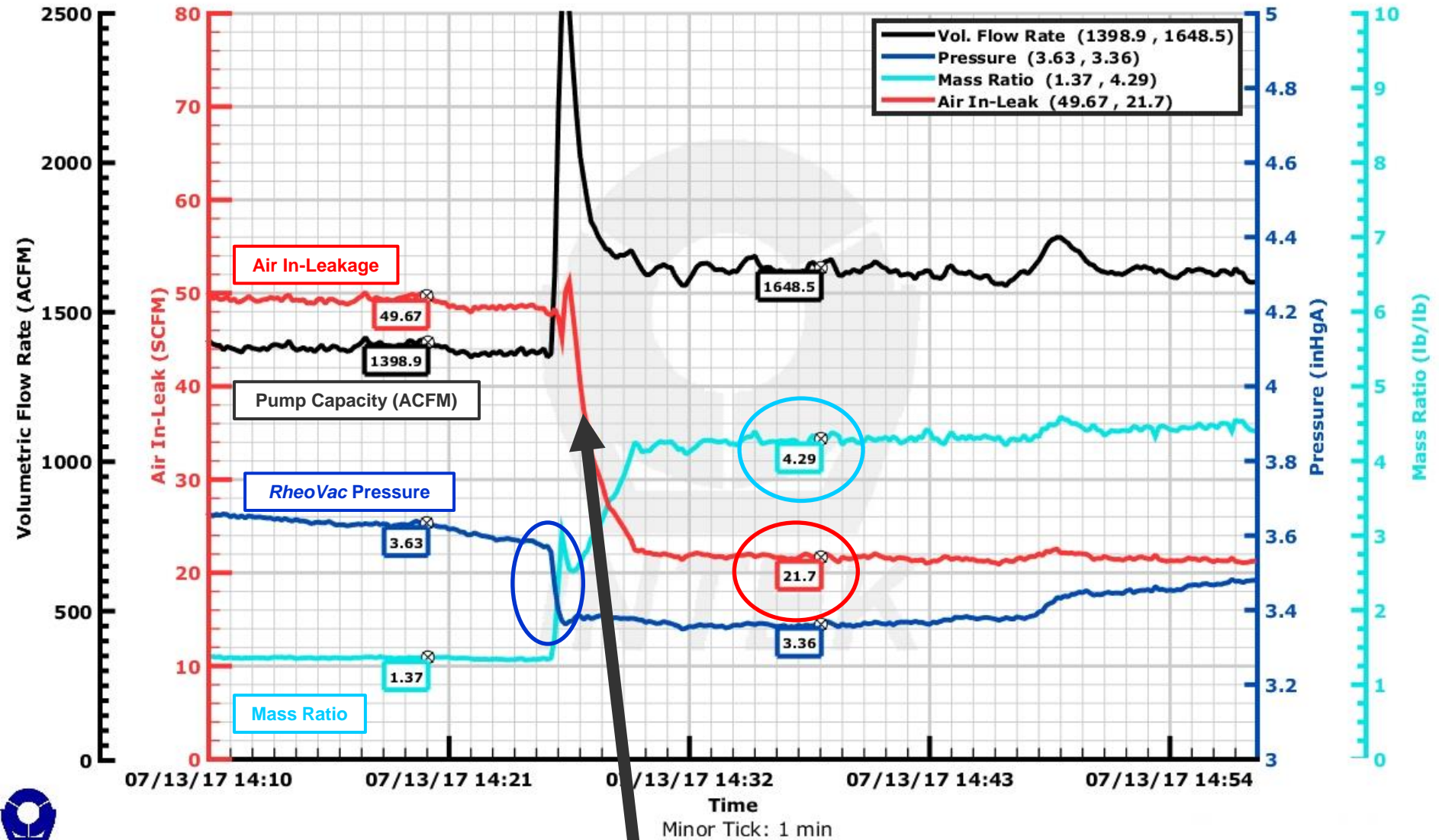


**Air In-Leakage &
Vacuum Equipment Capacity**

RheoVac Parameters

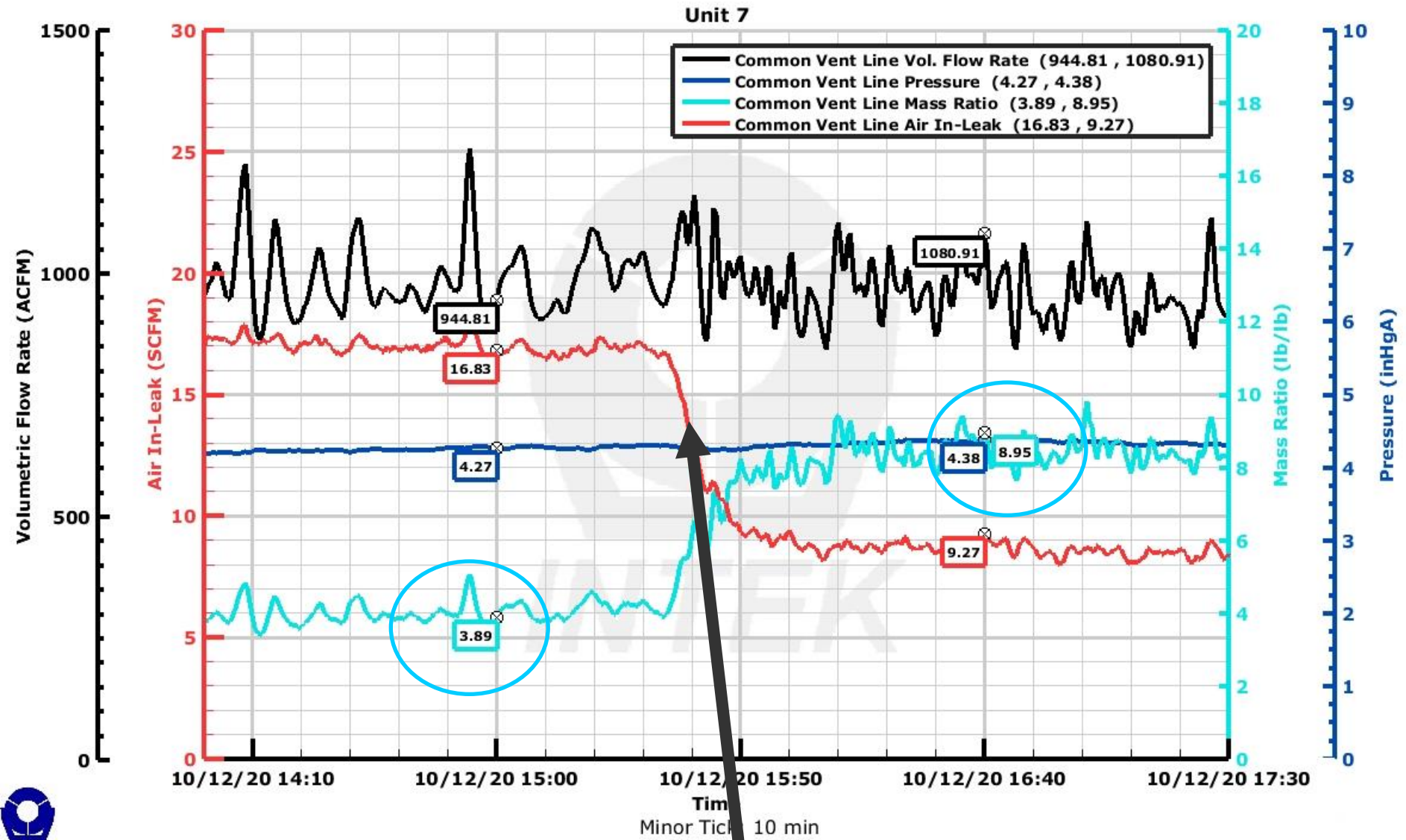
- **Plant diagnostic significance of *RheoVac* parameters**
 - **Air in-leakage** - An absolute reading of all noncondensable gases
 - **Mass ratio** (\dot{m}_{wv} / \dot{m}_a) - This value is a measure of vacuum quality, a value above ~3 indicates no excess back pressure present due to air in-leakage (stagnant zone)
 - **ACFM** - A probe located in a common header before a cylinder pump or liquid ring vacuum pump will show pump capacity
 - **Mass flow** - A probe located in a common header before a steam jet air ejector will show ejector capacity

Case Study 1



Leak Fixed

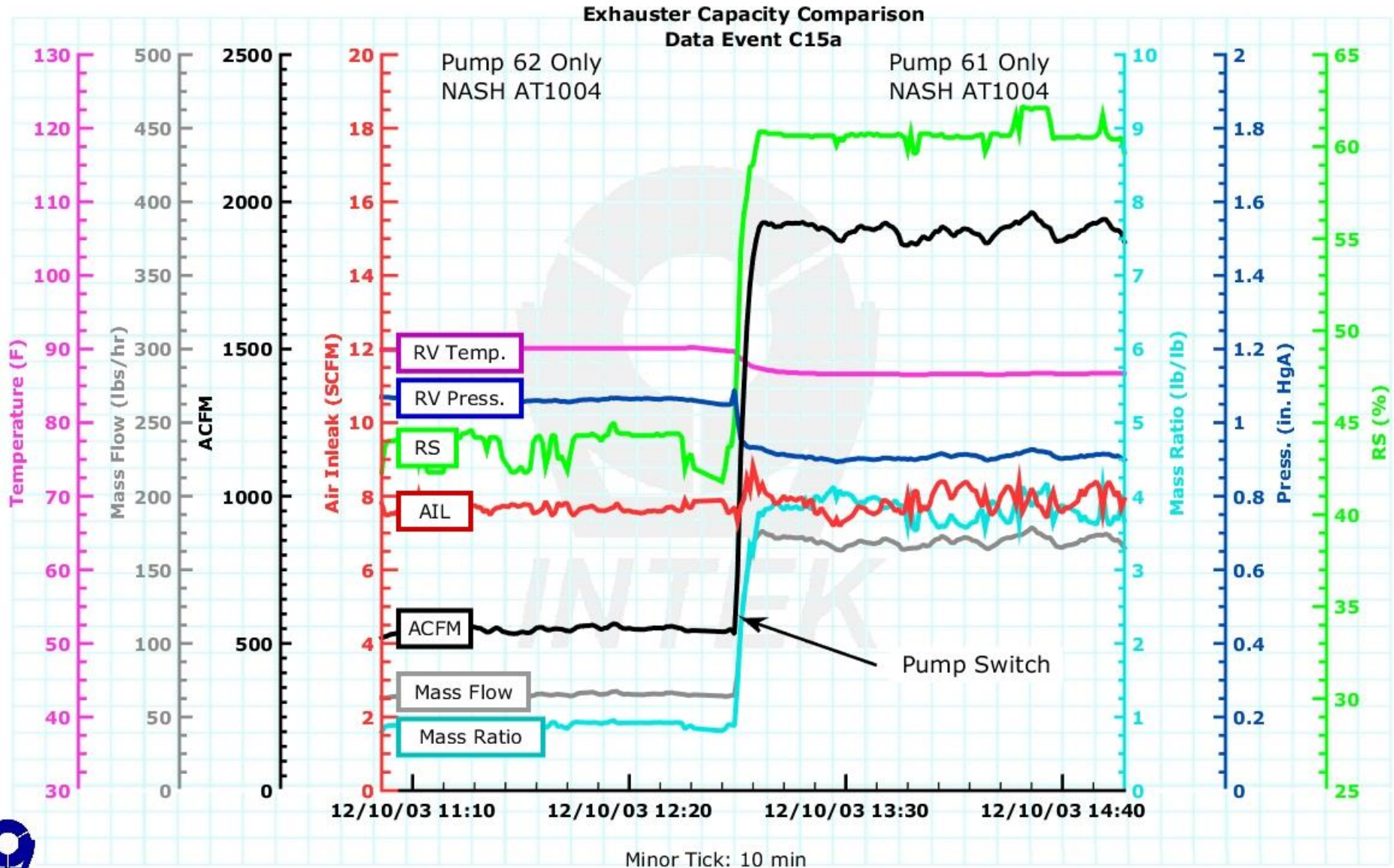
Case Study 2



Leak Fixed

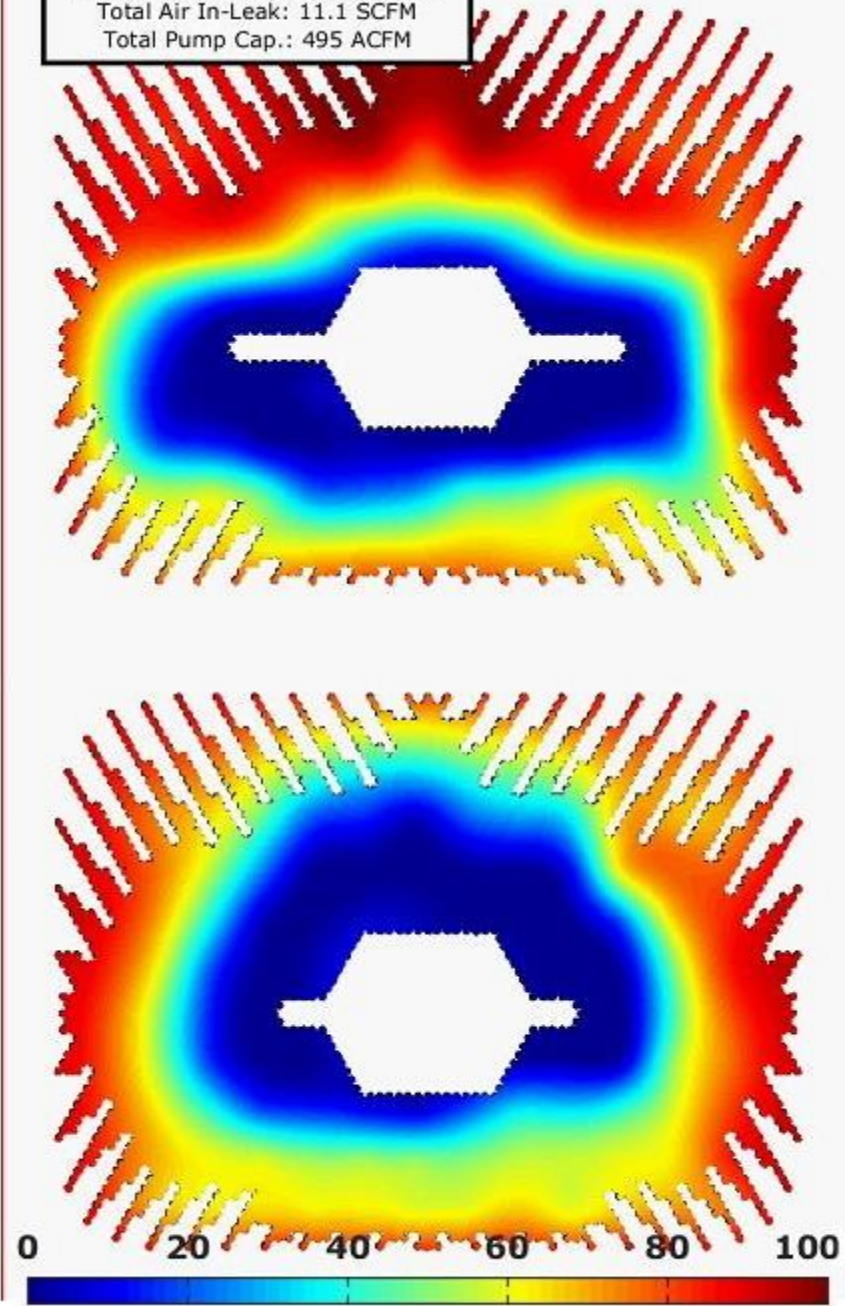
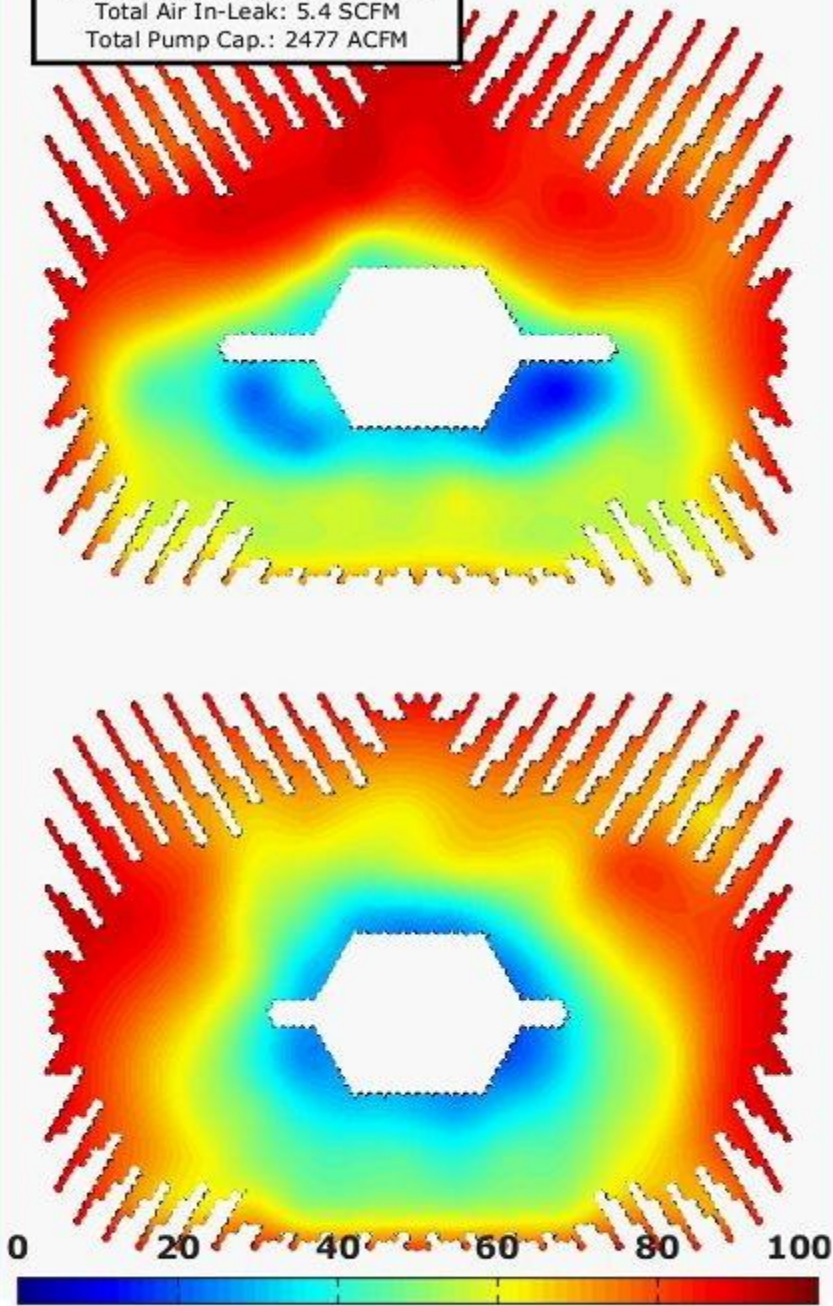


Case Study 3



Bundle Cleanliness Factor: 70.3%
Total Air In-Leak: 5.4 SCFM
Total Pump Cap.: 2477 ACFM

Bundle Cleanliness Factor: 57.8%
Total Air In-Leak: 11.1 SCFM
Total Pump Cap.: 495 ACFM



HEI Cleanliness Factor

HEI Cleanliness Factor

END

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